

Digital Design

5th edition

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CH1 Digital systems & Binary Numbers

1.1 →

1.2 Binary Numbers

$$7392 = 7000 + 300 + 90 + 2$$

$$\rightarrow = 7 \times 10^3 + 3 \times 10^2 + 9 \times 10^1 + 2 \times 10^0 \quad \leftarrow$$

0 → 9

الأسد من الأسفل إلى الأعلى

0 → 9	0 → 9	0 → 9
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$$(26.75)_{10} = 20 + 6 + 0.7 + 0.05 \quad a_{-2} \cdot r^{-2}$$
$$\rightarrow = 2 \times 10^1 + 6 \times 10^0 + 7 \times 10^{-1} + 5 \times 10^{-2} \quad \leftarrow$$

$$a_n \cdot r^n + a_{n-1} \cdot r^{n-1} + \dots + a_2 \cdot r^2 + a_1 \cdot r^1 + a_0$$
$$+ a_{-1} \cdot r^{-1} + a_{-2} \cdot r^{-2} + \dots + a_{-m} \cdot r^{-m} \quad \text{radix} \equiv \text{base}$$

$$10 = r \quad a_1 = 2 \quad a_0 = 6 \quad a_{-1} = 7 \quad a_{-2} = 5$$

$$(26.75)_{10} = (11010.11)_2$$

↑ ← → ↑

$$(11010.11)_2 = a_4 \cdot r^4 + a_3 \cdot r^3 + a_2 \cdot r^2 + a_1 \cdot r^1 + a_0 + a_{-1} \cdot r^{-1} + a_{-2} \cdot r^{-2}$$
$$\begin{matrix} a_4 & a_3 & a_2 & a_1 & a_0 & a_{-1} & a_{-2} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \end{matrix}$$
$$= 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 + 1 \times 2^{-1} + 1 \times 2^{-2}$$
$$\downarrow = (26.75)_{10}$$
$$r = 2$$

$$(4021.2)_5 = 4 \times 5^3 + 0 \times 5^2 + 2 \times 5^1 + 1 \times 5^0 + 2 \times 5^{-1}$$

a a a a a ↓ 5_i

$$8 = 5 = (511.4)_{10}$$

$$(127.4)_8 = 1 \times 8^2 + 2 \times 8^1 + 7 + 4 \times 8^{-1} = (87.5)_{10}$$

$$\text{base} = \underline{10} \quad (0 \rightarrow 9) \text{ } \uparrow \downarrow \text{ } 10$$

$$\text{base} = 5 \quad (0 \ 1 \ 2 \ 3 \ 4)$$

$$\text{base} = \underline{8} \quad (0 \rightarrow 7)$$

$$\text{base} = 16 \quad 0 \rightarrow 9, 10 \rightarrow 16$$

$$\left[\begin{array}{lll} A=10 & B=11 & C=12 \\ D=13 & E=14 & F=15 \end{array} \right] \quad (A \rightarrow F)$$

$$\text{base} = 16 \quad 0 \rightarrow 9, A \rightarrow F$$

$$(B65F)_{16} = 11 \times 16^3 + 6 \times 16^2 + 5 \times 16^1 + 15 \times 16^0 = (46687)_{10}$$

$$\text{addresses} \rightarrow \text{instructions} \rightarrow \text{ASCII}$$

$$(B65F)_{16} = (1101011001011111)_2$$

$$\text{addresses} \rightarrow \text{instructions} \rightarrow \text{ASCII}$$

$$\begin{aligned} 2^{10} &= 1K = 1024 \\ 2^{20} &= 1M \\ 2^{30} &= 1G \\ 2^{40} &= 1T \end{aligned}$$

$$\begin{aligned} 1T &= 1024G \\ 1G &= 1024M \\ 1M &= 1024K \\ 1K &= 1024 \end{aligned}$$

$$\begin{aligned} 2^{10} &= 1K \\ 2^{11} &= 2K \\ 2^{15} &= 32K \\ 2^{20} &= 1M \end{aligned}$$

Table 1.1
Powers of Two

n	2 ⁿ	n	2 ⁿ	n	2 ⁿ
0	1	8	256	16	65,536
1	2	9	512	17	131,072
2	4	10	1,024 (1K)	18	262,144
3	8	11	2,048	19	524,288
4	16	12	4,096 (4K)	20	1,048,576 (1M)
5	32	13	8,192	21	2,097,152
6	64	14	16,384	22	4,194,304
7	128	15	32,768	23	8,388,608

$$2 = 09$$

2⁵

2⁷

$$(110101)_2 = 32 + 16 + 4 + 1 = (53)_{10}$$

32 16 8 4 2 1
↓ ↓ ↓ ↓ ↓
2⁵ 2⁴ 2³ 2² 2¹ 2⁰

$$\begin{array}{r} 101101 \\ + 100111 \\ \hline \end{array}$$

$$\begin{array}{r} 45 \\ + 39 \\ \hline \end{array}$$

جمع

$$(1010100)_2$$

$$(1010100)_2 = 64 + 16 + 4 = (84)_{10}$$

64 32 16 8 4 2 1

$$(84)_{10}$$

$$\begin{array}{|c|c|c|c|} \hline 0 & 0 & 1 & 0 \\ \hline \end{array}$$

$$\begin{array}{|c|c|c|c|} \hline 0 & 1 & 0 & 0 \\ \hline \end{array}$$

$$\begin{array}{|c|c|c|c|} \hline 1 & 1 & 1 & 1 \\ \hline \end{array}$$

$$11 = 10 + 1$$

$$\begin{array}{r} 101101 \\ - 100111 \\ \hline (000110)_2 \\ (110)_2 = 4 + 2 = (6)_{10} \end{array}$$

$$(110)_2 = 4 + 2 = (6)_{10}$$

$$\begin{array}{r} 15 \\ - 9 \\ \hline (06)_{10} \end{array}$$

ع

$$\begin{array}{r}
 1011 \\
 \times 1011 \\
 \hline
 1011 \\
 0000 \\
 1011 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 1011 \\
 \hline
 (110111)_2
 \end{array}$$

32 16 8 4 2 1

$$(110111)_2 = 32 + \underbrace{16 + 4 + 2 + 1}_{52} = \underbrace{52}_{20} = (55)_{10}$$

$$\begin{array}{r}
 11 \\
 \times 5 \\
 \hline
 (55)_{10}
 \end{array}$$

9.5

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